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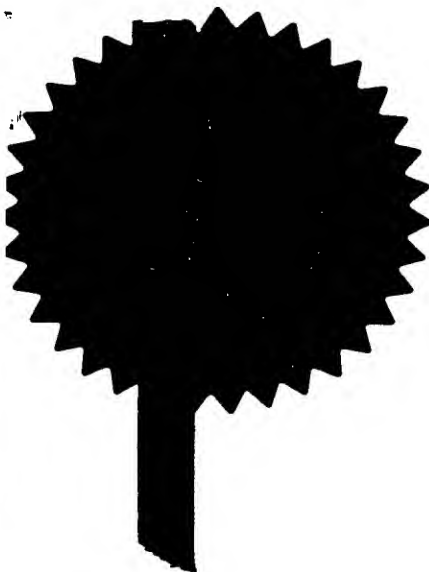
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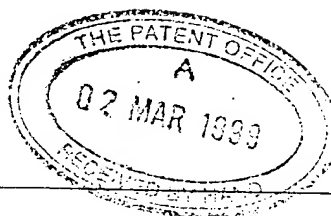
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# Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)



The Patent Office

Cardiff Road  
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1. Your reference

9052

2. Patent application number

(The Patent Office will fill in this part)

**9904808.4**

- 2 MAR 1999

3. Full name, address and postcode of the or of each applicant (underline all surnames)

BP OIL INTERNATIONAL LIMITED  
BRITANNIC HOUSE  
1 FINSBURY CIRCUS  
LONDON EC2M 7BA

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

ENGLAND, UNITED KINGDOM

"see continuation sheet

4. Title of the invention

OIL TREATMENT PROCESS

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

SMITH, Julian Philip Howard

BP INTERNATIONAL LIMITED  
GROUP PATENTS & AGREEMENTS  
CHERTSEY ROAD  
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TW16 7LN

Patents ADP number (if you know it)

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

YES

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
  - c) any named applicant is a corporate body.
- See note (d))

# Patents Form 1/77

9. Enter the number of sheets of any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description 6 *10831*

Claim(s) -

Abstract -

Drawing(s) 1 *1*

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination and search (*Patents Form 9/77*)

Request for substantive examination (*Patents Form 10/77*)

Any other documents  
(*please specify*)

11. I/We request the grant of a patent on the basis of this application.

Signature

Date 2.3.99

SMITH, Julian Philip Howard

12. Name and daytime telephone number of person to contact in the United Kingdom

01932 764092

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REQUEST FOR GRANT OF A PATENT  
'SECTION 3'

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### Oil Treatment Process

This invention relates to a process for the production of a process oil having an aromatic content of at least 20 % by weight and a polycyclic aromatic (PCA) content of less than 3 wt %. In this application, aromatic content is measured by the ASTM D 2007 method, and PCA content is measured by the IP 346 method.

5        Process oils are hydrocarbon mixtures that boil in the same temperature range as lubricant base oils, and like lubricant base oils, are derived from petroleum distillates by solvent extraction. However, unlike lubricant base oils which are rarely employed outside the lubricating field, process oils have a wide range of industrial applications. For example, they are used as solvents, anti-dust  
10       compounds, plasticisers and/or extenders for synthetic and natural rubbers, and in the manufacture of printing inks. In order to be suitable for these applications, the compositions of process oils have to be carefully controlled.

      Various methods of preparing process oils are known. For example, in GB 1 426 746, a petroleum distillate is contacted with furfural, and the resulting primary  
15       extract is re-extracted with furfural to produce a secondary extract and a pseudo-raffinate. The pseudo-raffinate is distilled from furfural, and then de-waxed and hydrogenated to produce a process oil.

      A problem with this process is that it produces a process oil having a low aromatic content as a result of the hydrogenation step. Aromatic compounds,  
20       however, impart solvent and swelling properties, which are desirable for a number of applications. The polycyclic aromatic (PCA) content of a process oil, however, should be kept to a minimum, because such compounds are undesirable for health and environmental reasons.

      In EP 0 417 980, a process oil having a high aromatic, and a PCA content of  
25       less than 3 weight % is prepared by re-extracting a primary extract under specific

temperature and solvent conditions. Specifically, the process is carried out in an extraction column operating at an extract to solvent ratio of 1:1 to 1:1.8, a column head temperature of 50 to 90°C, and a bottom temperature of 20 to 60°C. The bottom temperature of the column is defined as the lowest temperature in the  
5 extraction step. The head temperature of the column is the temperature at the uppermost region of the column. Generally, it is the highest temperature in the column.

We have now discovered an alternative route for the production of process oils. Specifically, the present process involves extracting the primary raffinate  
10 under specific operating conditions to produce a process oil having an aromatic content of at least 20 % by weight and a PCA content of less than 3 wt %.

FR 1 295 441 describes a process in which a primary raffinate is extracted in a second extraction step. However, the process conditions employed are such that process oils having the composition of the present invention are not produced.

15 Accordingly, the present invention provides a process for the production of a process oil, the process comprising:

- a) contacting a petroleum distillate with a polar solvent in an extraction column which operates with a bottom temperature of 30 to 80°C,
- b) withdrawing a primary raffinate from the column of step a),
- 20 c) contacting the primary raffinate with a polar solvent in an extraction column which operates at a bottom temperature that is higher than the bottom temperature of the extraction column of step a), and in the range of 60 to 90 °C,
- d) withdrawing a secondary extract from the column of step c), and
- e) removing said polar solvent from said secondary extract.

25 The process oils produced by the present invention have an aromatic content of more than 20% by weight and a PCA content of less than 3% by weight. Such process oils are suitable for a number of applications, for example, as solvents, anti-dust compounds, plasticisers and/or extenders for synthetic and natural rubbers, and in the manufacture of printing inks.

30 In step a), the petroleum distillate is contacted with a polar solvent in an extraction column. Without wishing to be bound by any theory, the polar solvent is believed to remove at least some of the PCA compounds originally present in the petroleum distillate. The procedure produces two phases: a primary extract at a lower portion of the column, and a primary raffinate at an upper portion of the  
35 column. The primary extract is solvent-rich and comprises naphthenic, and



polycyclic aromatic components. This extract is withdrawn from the base of the column. In a preferred embodiment, the polar solvent is removed from the extract and recycled.

Step a) may be carried out using an extraction column which operates at a  
5 bottom temperature of 30 to 80°C, preferably, 45 to 75°C, and especially 55 to 70°C. The bottom temperature of the first extraction step (a) is principally dependent on the temperature of the polar solvent and the petroleum distillate but may be controlled by additional cooling at the base of the extraction column. This temperature has an important influence on the selectivity and solvent power of the  
10 solvent employed in the present invention, which in turn, affects the final composition of the primary raffinate produced. In one embodiment, a temperature gradient is maintained along the extraction column, such that the head of the column is maintained at 80 to 120°C (head column temperature), whilst the bottom temperature is maintained at 60 to 90 °C (base column temperature). The  
15 temperature difference between the head temperature and the bottom temperature is from 5 to 70°C, preferably 30 to 50°C.

The amount of solvent relative to petroleum distillate employed may be in the range of 70 to 300 vol %, preferably, 100 to 250 vol %, and especially, 120 to 170 vol %. It should be recognised, however, that the precise solvent to distillate ratio  
20 used will depend on the type of distillate employed. For example, the solvent to distillate ratio may depend on the boiling range of the distillate, and/or its crude origin.

The primary raffinate produced in step a) is withdrawn from an upper portion of the extraction column and re-extracted with a polar solvent in a second solvent  
25 extraction step (Step c). The procedure produces two phases: a secondary extract at a lower portion of the column, and a secondary raffinate at an upper portion of the column. In one embodiment, 70 to 100% of the polar solvent is removed from the primary raffinate, before the primary raffinate is treated in the second solvent extraction step. Preferably, 95 to 100% of the polar solvent is removed. The  
30 bottom temperature employed in step c) is in the range of 40 to 90°C, preferably, 55 to 90°, and especially 75 to 90°C. In one embodiment, step c) is carried out using an extraction column having a head column temperature of 90 to 130 °C, and a bottom temperature of 70 to 100 °C. The temperature difference between the head temperature and bottom temperatures is 5 to 70°C, preferably 30 to 50°C.

35 The bottom temperature of the second extraction step (c) is dependent on the

temperature of the polar solvent and the primary raffinate. Like the bottom temperature of the first extraction step, however, the bottom temperature of the second extraction step may be controlled by additional cooling at the base of the extraction column. The second extraction step is carried out at a higher bottom temperature than step a). This increase in extraction temperature decreases the selectivity of the solvent. When the polar solvent is removed from the secondary extract in step e), a process oil having a PCA concentration of 3 wt % or less is produced. The overall aromatic content of the process oil is more than 20% by weight. The less soluble paraffinic components of the primary raffinate accumulate at an upper portion of the solvent extraction column as a secondary raffinate. This raffinate may be removed from the column, and distilled. The solvent recovered may be recycled for re-use. In one embodiment, the secondary raffinate is purified in distillation column, and then solvent dewaxed to produce a lubricant base oil (eg. 500N with 96 VI).

Step c) may be performed using a different extraction column to step a). Preferably, however, the same extraction column is employed for both steps.

The amount of solvent relative to petroleum distillate in the second extraction step employed may be in the range of 100 to 400 vol %, preferably, 180 to 300 vol %, and especially, 200 to 250 vol %. As with the first extraction step, the precise solvent to distillate ratio used will depend on the type of distillate employed. For example, the solvent to distillate ratio may depend on the boiling range of the distillate, and/or its crude origin.

Suitable polar solvents for solvent-extraction steps a) and c) include furfural, phenol and N-methylpyrrolidone. Preferably, furfural is employed.

These and other aspects of the present invention will now be described with reference to the accompanying drawing, which is a schematic view of an apparatus for use in a preferred embodiment of the present invention.

The drawing depicts an apparatus which comprises a first extraction column 10, a second extraction column 12, and four distillation columns 14, 16, 18 and 20.

In use, a petroleum distillate 24 is fed into the first extraction column 10 and contacted with furfural, which is fed into the extraction column 10 via line 22. The column 10 is operated at a bottom temperature of 70°C. The temperature at the head of the column 10 is 109 to 118°C. At least some of the polycyclic aromatic and naphthenic components in the distillate 24 dissolve in the furfural to form a primary extract 26. This is withdrawn from the base of the first extraction column

10, and is introduced into a distillation column 20 for purification. Once distilled, the extract is removed for disposal or otherwise.

The remaining components of the distillate 24 are withdrawn from the first extraction column 10 as a primary raffinate 28. The density of the raffinate 28 is  
5 measured at regular intervals to provide an indication of the PCA content of the raffinate.

The primary raffinate 28 is then introduced into a distillation column 14. The raffinate is isolated from the solvent, and introduced into the second extraction column 12 for further solvent extraction. Fresh furfural is introduced into the  
10 column 14 via line 36. The second extraction step is carried out at a bottom temperature of 75 °C. The head temperatures of the column is 107 to 115°C. The extraction step produces two phases: a secondary extract 30 at the base of the column 12, and a secondary raffinate 34 at the column head. The secondary extract 30 is withdrawn from the second extraction column 12 and purified in  
15 distillation column 16 to produce a process oil 32 having a polycyclic aromatic (PCA) content of less than 3 % by weight, and an aromatic content of more than 20 % by weight. As with the primary raffinate 28, the density of the secondary extract 30 is determined to provide an indication of the PCA content of the extract 30.

The less soluble components of the primary raffinate 28 are withdrawn from  
20 the head of the second extraction column 12 as a secondary raffinate 34. This secondary raffinate 34 is purified in distillation column 18 to produce a solvent-free raffinate 38 which is introduced into a solvent de-waxing unit 40. After solvent dewaxing to -9 °C pour point, a lubricant base oil (500N with 96 VI) 39 is  
25 produced.

The furfural recovered in columns 14, 16, 18 and 20 is recovered for re-use.

Instead of using two extraction columns, it is possible to use the same column for both extraction stages.

#### Example

30 In this Example, a waxy distillate obtained from Middle East crude suitable for lubricant base oil production is treated using the apparatus of Figure 1.

This distillate is fed into the first extraction column at a temperature of 77°C. Furfural is preheated to 118°C, and introduced into the first extraction column at a furfural to distillate ratio of 130 vol %. The extraction column is operated at a  
35 bottom temperature of 70°C. The temperature at the head of the column is 109°C.

The process conditions employed in the first solvent extraction stage are summarised in Table 2 below.

Table 2

primary raffinate yield	71 % vol
primary raffinate density at 70°C	0.856 g/ml
primary extract density at 70°C	1.006 g/ml

5

In the second solvent extraction stage, the primary raffinate is fed into the second extraction column at 77°C. Furfural is preheated to 115°C, and introduced into the extraction column at a wash rate of 260 vol %. The second extraction column is operated at a bottom temperature of 75°C. The temperature at the head of the column is 107°C. The process conditions employed in the second solvent extraction stage are summarised in Table 3 below.

10

Table 3

secondary raffinate yield	80 vol %
secondary raffinate density at 70°C	0.842 g/ml
secondary extract density at 70°C	0.926 g/ml

15

The secondary extract produced in this Example was analysed and found to have a IP 346 PCA content of 2.85 wt %, and an ASTM D-2007 aromatic content of 28 wt %. The VGC of the extract was measured using the ASTM D2140 test method, and found to be 0.90. The aniline point of the extract, as measured using ASTM D611, was 62.4 °C.

20

Various modifications may be made to the embodiment described above without departing from the scope of this invention. For example, instead of using density measurements to provide an indication of the PCA content of a particular extract and/or raffinate, refractive index, near infra-red spectroscopy or chromatographic techniques may also be employed.

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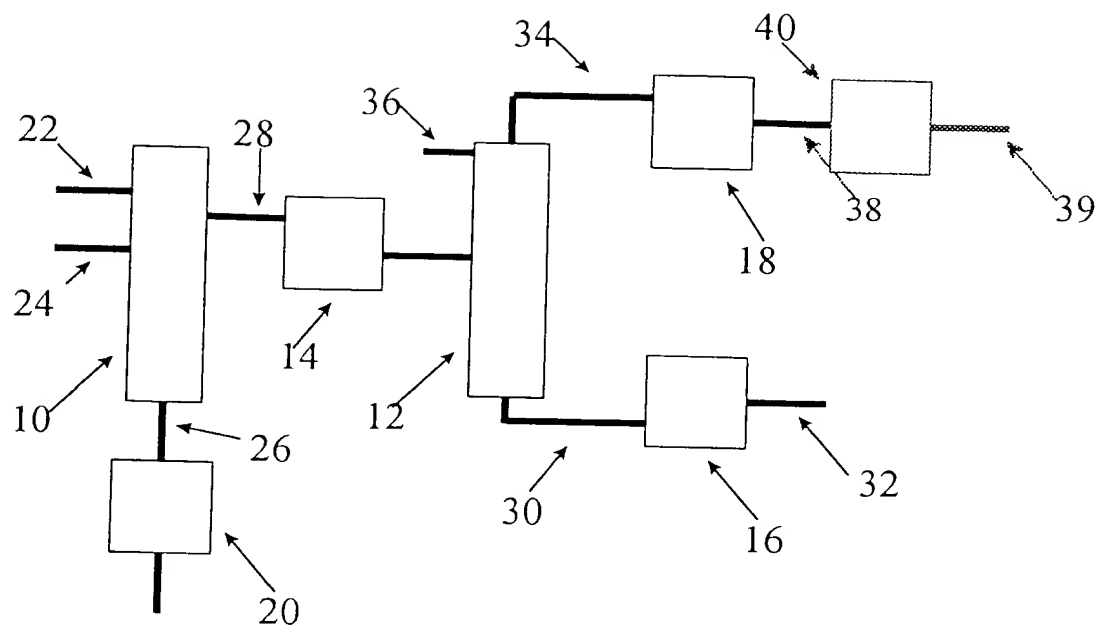


Figure 1

PCT. NO. G600 / 00635

form 23/77 : 23/2/00

Agent : BP International Ltd